Claims

1. A reformate cooling system for reducing the temperature of a reformate to within a desired temperature range for use in a fuel processing subsystem, the fuel processing subsystem including a process water flow that supplies water to a fuel flow in the fuel processing subsystem; the reformate cooling system comprising:

at least one heat exchanger unit to transfer heat from the reformate flow to a portion of the process water flow, the at least one heat exchanger including a coolant inlet, a coolant outlet, a coolant flow path to direct the portion of the process water flow from the coolant inlet to the coolant outlet, a reformate inlet, a reformate outlet, and a reformate flow path to direct the reformate flow from the reformate inlet to the reformate outlet with a concurrent flow relationship between the portion of the process water flow in the coolant flow path and reformate flow in the reformate flow path, the heat exchanger having a sufficient effectiveness to fully vaporize the portion of the process water flow and bring the reformate flow and the portion of the process water flow toward a common exit temperature under normal operating conditions for the fuel processing subsystem;

a valve connected to the coolant inlet to control the flow rate of said portion of the process water flow to the coolant inlet;

a temperature sensor positioned to measure an outlet temperature of the reformate;

a controller connected to the temperature sensor and responsive thereto to selectively control the portion of the process water flow via the valve to regulate the common exit temperature to a desired temperature range.

2. The reformate cooling system of claim 1 wherein an auto-thermal reformer receives the portion of the process water flow from the coolant outlet and mixes the portion of the process water flow with the fuel flow.

3. The reformate cooling system of claim 1 wherein the temperature sensor is positioned at the reformate outlet.

4. The reformate cooling system of claim 1 wherein the temperature sensor is positioned at the coolant outlet.

5. The reformate cooling system of claim 1 wherein the controller is electronically coupled to the temperature sensor.

6. A method of operating a reformate cooling system for reducing the temperature of a reformate to within a desired temperature range for use in a fuel processing subsystem, the fuel processing subsystem including a process water flow that supplies water to a fuel flow in the fuel processing subsystem, the method comprising the steps of:

flowing a reformate through a first flow path;

flowing a portion of the process water through a second flow path with a concurrent flow relationship to the first flow path;

transferring heat from the reformate to the portion of the process water whereby the portion of the process water is fully vaporized and the reformate and the portion of the process water approach a common exit temperature; and

controlling the portion of the process water flow rate to regulate the temperature of the reformate exiting the first flow path.

7. The method of claim 6 further comprising the step of adjusting the temperature range of the reformate exiting the first flow path in response to changes in catalytic activity in a hydrogen purification device receiving said reformate exiting the first flow path.

8. The method of claim 6 further comprising the step of recombining the portion of the process water flow with a remainder of the process water flow.

9. The method of claim 8 further comprising the step of transferring the recombined process water flow to an auto-thermal reformer.

10. A reformate cooling system for reducing the temperature of a reformate to within a desired temperature range for use in a fuel processing subsystem, the fuel processing subsystem including a process water flow that supplies water to a fuel flow in the fuel processing subsystem; the reformate cooling system comprising:

at least one heat exchanger unit to transfer heat from the reformate flow to a portion of the process water flow, the at least one heat exchanger including a coolant inlet, a coolant outlet, a coolant flow path to direct the portion of the process water flow from the coolant inlet to the coolant outlet, a reformate inlet, a reformate outlet, and a reformate flow path to direct the reformate flow from the reformate inlet to the reformate outlet with a concurrent flow relationship between the portion of the process water flow in the coolant flow path and reformate flow in the reformate flow path, the heat exchanger having a sufficient effectiveness to fully vaporize the portion of the process water flow and bring the reformate flow and the portion of the process water flow toward a common exit temperature under normal operating conditions for the fuel processing subsystem;

an active control loop to control the flow rate of the portion of the process water flow through the heat exchanger to maintain the common exit temperature within the desired temperature range.

11. The reformate cooling system of claim 10 wherein the active control loop is a feedback control loop.

12. The reformate cooling system of claim 11 wherein the active control loop includes a valve to control the flow rate of the portion of the process water flow.

13. The reformate cooling system of claim 12 wherein the active control loop monitors the reformate outlet temperature.

14. The reformate cooling system of claim 10 wherein the coolant outlet is connected to an auto-thermal reformer.